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INTERNATIONAL PARTNERS

Make A World of Difference

Contents

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ON THE COVER

Strands of cooperative endeavor bind the world of geospatial intelligence. "The GEOINT world of 2006 is larger, more dynamic and more complex than anything we have seen before"—Robert Weber, NGA Director of International Affairs and Policy. Photo © Getty Images.

GETTING PUBLISHED

All members of the geospatial intelligence community are welcome to submit articles of community-wide interest. Articles are edited for style, content and length. The copy deadline is the last Friday of the third month before publication. For details on submitting articles, e-mail the Pathfinder. Our address is pathfinder@nga.mil.

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GEOINT's Global Impact

Letter to our Readers

In this issue, the fifth in our series on how geospatial intelligence makes a difference, we look at the global impact of GEOINT through the combined efforts of NGA and its partners in many nations. Both the United States and our partners have national security concerns that are informed by the power of GEOINT.

In past issues, we have shown how, increasingly, our nation turns to NGA for expertise to fulfill its role as global leader—securing freedom, defeating threats and saving lives. This issue shows how NGA itself has a global leadership role—promoting the power of GEOINT for these same reasons: securing freedom, defeating threats and saving lives.

As you read through the articles, you will see NGA in this leadership role. You will also see NGA as a collaborator and enabler, building global GEOINT capabilities and using them, with countries large and small around the world. I'd like to highlight just a few examples:

Even as NGA remains the world leader for GEOINT, our Agency is witnessing a revolution in global GEOINT, states the Director of the Office of International Affairs and Policy, Robert Weber, in our lead article. This revolution confronts NGA with significant complexity but also considerable options to move in new directions and forge new relationships to fulfill our mission and meet the policymakers' and warfighters' needs for GEOINT.

The benefits of collaboration to both NGA and our partners can be dramatic, like the "triumph" in resolving the boundary between El Salvador and Honduras described by John Gates in his first-person account in this issue. More often, they are transparent, like the international effort to adopt common geographical standards described by Dr. Cliff Kottman ("NGA Leads International Standardization Effort").

As an enabler, NGA is working alongside the strategically important nation of Mongolia to build GEOINT capabilities. Through this partnership Mongolia has obtained a modern geodetic foundation for accurate mapping, land valuation and geographic information systems, writes author Steve Kenyon. In the same project, NGA has improved its global coordinate frame, World Geodetic System 84.

Collaboration again takes center stage in our article on mapping the world's landmass in digits. This milestone—achieved in December—happened only because 19 nations joined together in an unprecedented co-production effort led by NGA, writes author Damien Kerr. The result is a geospatial features database called "VMap" that should prove as valuable on land as NGA's Digital Nautical Chart™ is at sea.

In the next Pathfinder, we will conclude our story on how NGA makes a difference, with the spotlight on NGA's role in the Intelligence Community. Clearly, NGA continues to lead as we "Know the Earth and Show the Way."

Mark Schultz
Director, Office of Corporate Relations

On My Mind

Building a Global GEOINT Community

By Lt. Gen. James R. Clapper, Jr., USAF (Ret.), Director, National Geospatial-Intelligence Agency

Our Director of National Intelligence, Ambassador John D. Negroponte, has emphasized the need for the Intelligence Community to "take stock" of its foreign-intelligence relationships and establish valuable, new partnerships that will help address 21st century intelligence challenges. After all, intelligence is a vital element in almost every substantial international activity of the U.S. government, and the "globalization" of intelligence data has enabled intelligence organizations around the world to partner in support of critical operations in the global war on terrorism as well as disaster and humanitarian relief missions. International partnering is truly making a difference.

At NGA, we have capitalized on the phenomenon of globalization. Over many years we and our international partners have forged relationships and fostered new ones. NGA is not only keeping pace with the globalization of geospatial intelligence (GEOINT), but, for some time, we have been providing both thought and leadership toward shaping and building what can be called a "global GEOINT community." Our work as a part of the Multinational Geospatial Co-production Program (MGCP) is a prime example of a solid international partnership whose ultimate goal is to provide participating nations and their GEOINT customers with the most timely, relevant and accurate data available.

Conceived in November 2003, the five-year MGCP initiative represents a multinational effort among 28 countries to co-produce geospatial data. Co-production minimizes duplication of effort and associated costs that participating nations would otherwise bear. The MGCP is helping to build a global GEOINT community by promoting the critical concepts of sharing GEOINT and cooperation among participating countries and by enabling the interoperability of critical geospatial data.

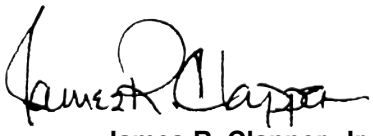
The program is designed to coordinate production and dissemination of high-resolution digital vector data over high-interest regions where only limited data or no data currently exists. Vector data are digitized lines, points and polygons that represent features on the Earth. This kind of critical locational data can support a variety of military and relief and recovery operations. It can also be used to support the global war on terrorism. Assurances that geospatial data be releasable to our coalition forces are no longer a nicety, but a requirement. Similarly, natural disasters such as the recent earthquakes in Pakistan or the tsunami that struck countries around the Indian Ocean highlight the need for timely access to the best geospatial data available. MGCP is helping to ensure that the critical information sharing we need occurs.

Data produced by the MGCP will reside in the NGA-sponsored International Geospatial Warehouse (IGW) which is expected to launch in 2006 via Web portal. Although data housed in the IGW will be unclassified—enabling rapid exchanges of data between participating nations—the information will be controlled and protected.

MGCP participants are organized into Lead Nations and Associate Nations. Eleven countries form the Steering Group (SG), composed of all Lead Nations and chaired by NGA. Lead Nations are challenged with producing more geospatial data, accepting data quality assurance responsibilities and having greater administrative and managerial obligations, but

these challenges provide greater benefits. Lead Nations will be able to extract larger amounts of data than Associate Nations. The overall data rate of return will be commensurate with a mission partner's production rate—the more a participant produces, the more data will be available to the participant.

Building a global GEOINT community ties in well with NGA's vision of "Know the Earth ... Show the Way." Building international partnerships with the goal of producing the best GEOINT possible is a necessity as our world confronts this century's intelligence challenges. While NGA's focus on the MGCP represents a further step toward global GEOINT collaboration, it is the daily, detailed work of all our NGA personnel and each participating nation that has delivered and will continue to deliver timely, relevant and accurate results for current and future generations around the world.



James R. Clapper, Jr.
Lieutenant General, USAF (Ret.)
Director

First Quadripartite Enterprise Board Meets

NGA Director retired Air Force Lt. Gen. James R. Clapper Jr., second from left, attends the first Quadripartite Enterprise Board (QEB) with counterparts from Australia, Canada and the United Kingdom. The QEB is a senior-level forum designed to coordinate the geospatial-intelligence policies, production, capabilities and acquisition issues of the quadripartite partners. Others, from left, are Ian McKenzie, Director of the Defence Imagery and Geospatial Organization in Australia; Air Vice Marshal Stuart Peach, Director of the General Intelligence Collection in the United Kingdom; and Brigadier-General Glenn Nordick, Chief of Defence Intelligence in Canada. The meeting took place in London last May.

Guest Column

Your Canadian Partner

By Lieutenant-Colonel R.S. Williams, Commanding Officer
Canadian Forces Joint Imagery Centre

OTTAWA—When I initially thought about writing an article for the Pathfinder, I envisioned that it might well be the standard "Here's who we are" description. However, the destruction wrought by Hurricane Katrina has changed the way in which I had intended to write this article. Our first reaction in Canada was "What can we do to help our American friends and neighbours?" and more particularly from my point of view, "What can we at the Canadian Forces Joint Imagery Centre (CFJIC) do to assist our colleagues at NGA?"

Through history our relationship has ranged from conflict to staunch allies. In the words of the late U.S. President Harry S Truman while addressing the Canadian Parliament in 1947, "Canadian-American relations for many years did not develop spontaneously. The example of accord provided by our two countries did not come about merely through the happy circumstance of geography. It is compounded of one part proximity and nine parts good will and common sense." Our support in the aftermath of Hurricane Katrina is ongoing both here in Canada and in the United States of America and will continue. Good will and common sense continue to be applied.

CFJIC is the focal point for Canadian Defence Imagery in support of Canadian Forces (CF) operations. The establishment of CFJIC on June 21, 2001 resulted from the merger of the Canadian Forces Photographic Unit and the imagery intelligence element of the then Director of General Intelligence. Since its inception, CFJIC has provided support to the majority of CF operations, including the ongoing war on terrorism. Unit personnel are currently deployed on overseas missions to support deployed forces and provide specialist advice and products.

The Unit is comprised of civilian (Department of National Defence—DND) and military (CF) personnel from a variety of backgrounds and trade specialties. Our link to NGA is strengthened by the permanent basing of two NGA Liaison Officers (LOs). I consider the Unit to be extremely fortunate in having our U.S. colleagues to provide invaluable advice, contacts and professional steerage to me personally and to all members of my Unit. I will admit that we at the Unit cut them some slack when it comes to pronunciation of some of our words, unique Canadian spelling of certain words and comments on our weather. The basing of two Canadian LOs in Bethesda solidifies our link across the 49th parallel. I must admit, I have never heard my U.S.-based Canadian colleagues complain about the weather!

Although some naysayers may argue that living next to a powerful neighbour with seemingly unlimited resources may appear daunting to us, I for one have never felt like the poor cousin in our relationship with NGA and its predecessors. In our collaborative endeavours, we are made to feel as equal partners. I believe that the late President Truman would be pleased to know that the application of good will and common sense is not an outdated concept between our two nations.

The **WORLDWIDE GEOINT** Revolution and NGA

By Robert Weber
Director, Office of International Affairs and Policy

During the past two decades, geospatial intelligence (GEOINT) has literally gone from non-existence to prominence around the globe. Or, more precisely, top quality GEOINT is prepared around the world by military and civilian organizations with pretty much the same objective as NGA—that is, to produce the best possible insight on natural and man-made activities on the Earth.

The GEOINT world of 2006 is larger, more dynamic and more complex than anything we have seen before. Space-based imagery collection began with Corona in the 1960s, and the first Landsat was launched in 1972. But the rapid advances in digital computing, geographic information system (GIS) software and imagery collection, coupled with the advent of the Global Positioning System (GPS) and other technologies, have revolutionized imagery analysis, mapping and charting. The advances are remarkable, and many nations around the world are able to use the capabilities with greater and greater skill.

In the last 20 years, a host of countries and private-sector entities have broken into what was once a near-U.S. monopoly in imagery collection and analysis, yielding nothing less than a revolution in the GEOINT world. This globalization of access to imagery and geospatial data brings home a new, profound reality for NGA—"We are not alone" as world-class collectors, providers and analysts of GEOINT.

To touch upon a few of the world's increasingly GEOINT-savvy nations:

- France launched its first commercial SPOT satellite in February 1986. This was a precursor to its Helios intelligence-gathering system. By the end of this decade, France will operate a third generation of satellites, the dual-use, intelligence-commercial Pleiades constellation. In addition, France is the leader of the "technical group," which is part of the Multinational Geospatial Co-production Project (MGCP) that will map Africa and other areas in more detail than ever before.
- South Korea soon will have its own high-quality commercial imagery satellite called KOMPSAT-2, Seoul's first one-meter resolution system.
- This year, Germany will put into orbit two different kinds of high-quality radar imaging satellites, a breakthrough for a European government. Moreover, Europe as a whole is pursuing a new program called Global Monitoring for Environment and Security (GMES). Analyzing the data from GMES would be a major step in the globalization of GEOINT.
- Israel and India both continue significant efforts to develop and operate an array of sophisticated imagery satellites for both military and commercial purposes.

Meanwhile, commercial firms or research organizations from around the world have followed U.S. firms as for-profit (usually) providers of imagery and value-added services. These international firms have acted alone or in partnership with their national governments. For example, TopSat, a new British-developed experimental microsatellite, will support a variety of government, military and civilian efforts. Likewise, Canada is preparing to launch a

second commercial radar imaging satellite, Radarsat-2. Indeed, gaining access to the output of these commercial systems is as easy as using the Internet, and many nations attend GEOINT symposia held in the United States and elsewhere, mainly to build relationships in the international GEOINT community and market their capabilities.

- The Google Earth phenomena, while still short on providing timely access to current imagery on a global basis, nonetheless has enabled increased accessibility to imagery for consumers and piqued appetites for more.
- Nearly two dozen countries were represented at last autumn's GEOINT 2005 conference in San Antonio. Organized by the private sector, the conference is a forum for companies and researchers in the remote-sensing business. Such robust representation was a clear reflection of the growing breadth of interest and capability in remote sensing and GEOINT.

The growth in global GEOINT capabilities is hardly restricted to imagery. Big steps forward in mapping and geospatial analysis are manifest in the success of the NGA-led Vector Map1 program, a collaboration of 19 countries that co-produced maps over a 12-year period. The MGCP initiative aims to go further—it harnesses the capabilities of nearly 30 countries to produce a new generation of increasingly sophisticated geospatial data sets.

- Thanks to the end of the Cold War, new allies such as those in Eastern Europe have joined the open geospatial world and now help to meet NGA's goals.
- The power of GIS software has enabled international GEOINT collaboration because the production tools are commercially available. According to the RAND Corporation, the first computerized GIS was developed in the 1960s. It evolved into an R&D tool in the 1970s. Throughout the 1980s and early 1990s it still had only niche applications because GIS usage required significant technical expertise and special computers. By the late 1990s, however, GIS took off, driven by commercial, off-the-shelf software on standard personal computers. Because the vast majority of business and government data have a geospatial component, GIS is an enabling technology that is advancing GEOINT on a global basis.

A Force Multiplier for NGA

The globalized, privatized and energized GEOINT world offers NGA a wide range of choices—and attractive ones at that—to go after the collection and analysis it needs to complement its in-house capabilities for fulfilling its intelligence consumers' expectations. As such, NGA plans to enhance its current international initiatives—such as its traditional collaborations with key Australian, Canadian and British allies—as well as consider wholly new directions that can help fill collection gaps, enhance NGA analysis and increase our flexibility to focus more resources on the hardest of targets. For instance, pursuing new avenues for working with our liaison partners, such as expanding exchanges or sharing analytic techniques, not only raises the prospect of reaping more deliverables for NGA but also of imbedding the Agency more deeply into the globalized GEOINT realm. Indeed, U.S. policymakers' and warfighters' needs for GEOINT are only growing, confronting NGA with constant challenges and requests for products to understand what is happening on our planet.

That is why partnering with foreign experts in this field makes sense. And that is why those of us who work at NGA must understand and take advantage of ideas and solutions outside our own Agency.

Resolution of El Salvador–Honduras Boundary

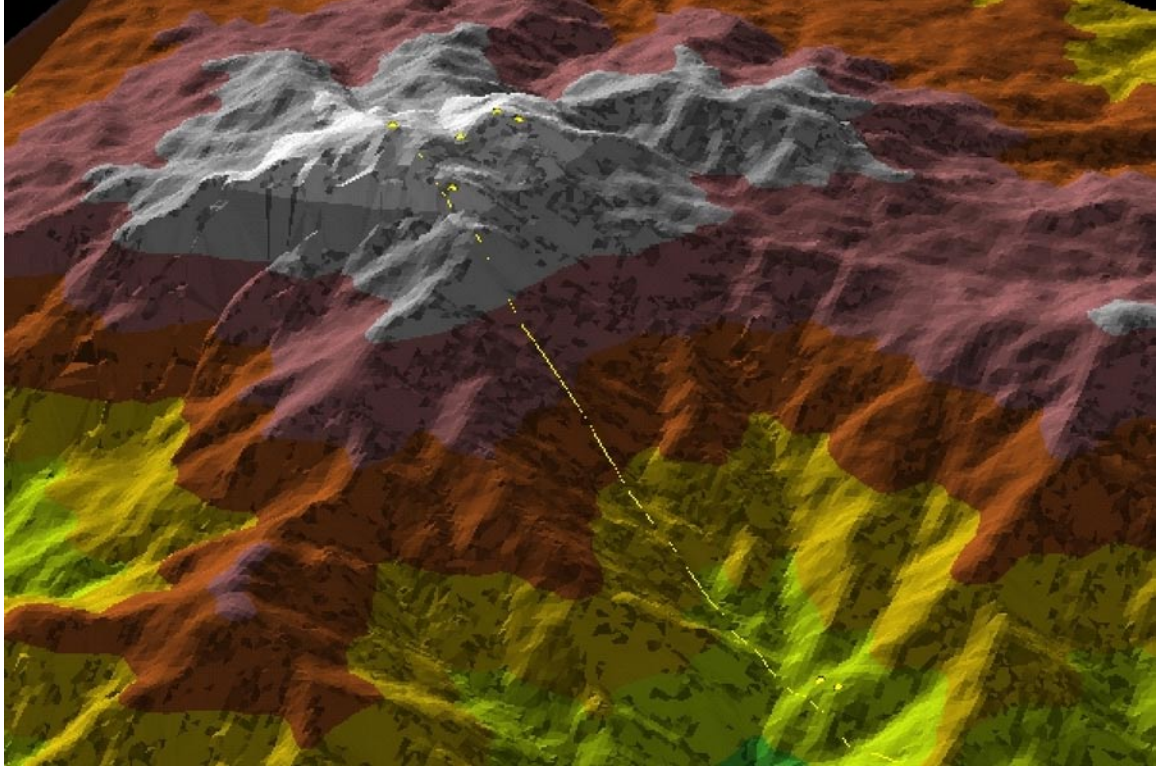
A Triumph of Political Will, Perseverance and Geospatial Analysis

By John Gates

NGA geospatial analysis was instrumental in the resolution of boundary disputes between El Salvador and Honduras.

In early 2003, the governments of El Salvador and Honduras requested that the Pan American Institute of Geography and History (PAIGH), a special activity of the Organization of American States (OAS), assist in the final resolution of outstanding differences in the placement of their common boundary. Working within a legal and technical framework established by the 1980 General Peace Treaty between the two countries, I was named by the OAS as an independent arbiter empowered to resolve these final differences in an expedient and judicious manner. Based on documents submitted by the disputing parties, the 1992 International Court of Justice adjudication, visits to the border area, ancillary historical documents, and analysis of geospatial information developed within NGA, I presented binding decisions back to the parties. At the time of this writing, all but one of the decisions have been fully implemented. This is a historic achievement for El Salvador and Honduras, who have disputed their common border since their independence from Spanish colonial rule. This article explains the history behind the conflict and how it was finally resolved by concerted political will of the governments, resolve of the representatives of the governments, and utilization of advanced geospatial analysis.

The 1980 General Peace Treaty led to the demarcation of 232 km of the 375 km of their common border. The remaining six bolsones, or pockets of dispute, are depicted in red.



Computer-generated perspective views, including this view of the El Pital mountain, were used by the arbiter as a visual aid to understand the terrain and the ramifications of the placement of the new.boundary line, depicted in yellow in the perspective.

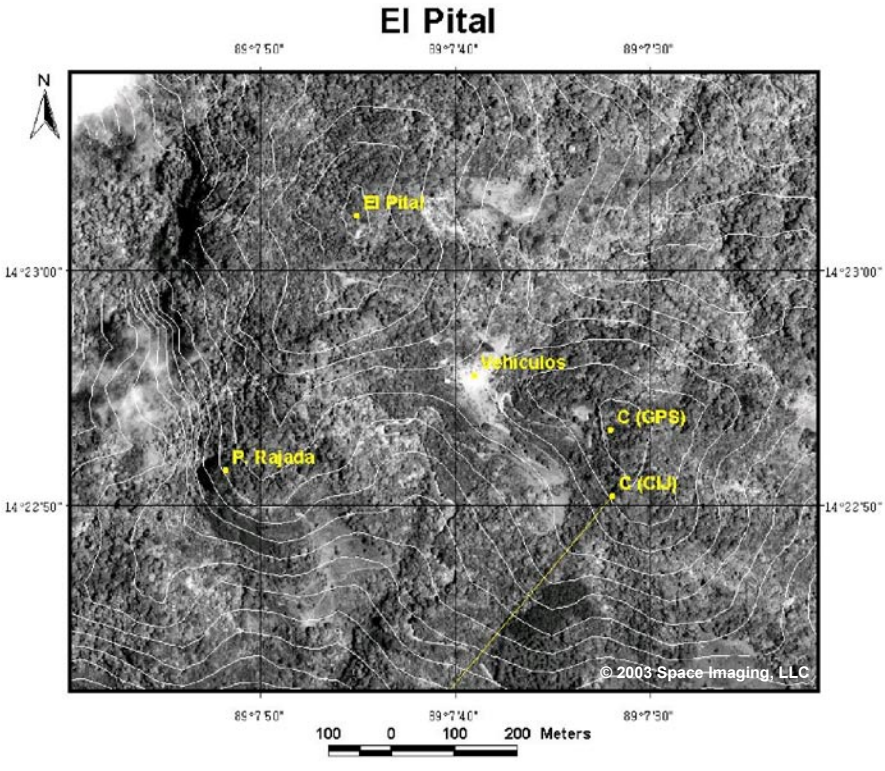
Historical Synopsis

After Spanish rule of Central America ended in 1821, a Federation of Central American States was first formed from the provinces of the Spanish Captaincy-General of Guatemala. However, this federation was completely dissolved by 1838 and replaced by the independent Central American republics of Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua. As was the normal procedure in Spanish America, the new international boundary was drawn in accordance with the principle of *uti posseditis juris*, following the existing colonial administrative boundaries. This principle has generally worked very well in Latin America as former Spanish colonies peacefully established boundaries between the newly formed independent nations. The El Salvador–Honduras boundary is an unfortunate exception. While under Spanish rule, the administrative boundary lines between adjoining provinces had little real significance, especially in remote mountainous areas where indigenous communities traditionally shared territory for growing crops and grazing animals. As a result, the boundary lines were poorly defined and based on surveys with little relevance to existing geography. In the case of densely populated land frontiers and hotly contested maritime boundaries between El Salvador and Honduras, these discrepancies led to violence that is only now reaching definitive resolution.

Throughout the late 19th century, there were numerous attempts at mediation, and the issue continued to fester into the 20th century. What pushed the two sides to war was largely rooted in economic issues: El Salvador is a small, densely populated country with little available space to grow. By the 1960s, an estimated 300,000 Salvadorans had drifted over the border into the more sparsely populated Honduras. Reacting to public outcry fueled by inflammatory press reports and frustration with growing internal economic and political problems, the government of Honduras began to forcibly displace the Salvadoran squatters. Press reports of these increasingly violent evictions circulated throughout El Salvador, bringing the situation to a boiling point during the summer of 1969.

The tensions between El Salvador and Honduras erupted during the World Cup qualifying soccer matches between their

national teams in June 1969. All three matches, held in Honduras, El Salvador and Mexico, were marked by violence and fanned public resentment in both countries. (El Salvador ultimately qualified but did not advance any further than the first round during the 1970 World Cup, won by Brazil with the legendary Pele.) Honduras broke diplomatic relations with El Salvador on June 27, 1969, and general war broke out on July 14, 1969. El Salvador launched a surprise air campaign deep inside Honduran territory but could not sustain a concerted ground attack because of fuel and ammunition shortages. Moreover, the Honduran air force largely destroyed the smaller Salvadoran air force and severely damaged El Salvador's oil storage facilities. The OAS stepped in almost immediately to broker a cease-fire, which took effect four days after the onset of open warfare. By Aug. 2, 1969, all Salvadoran troops had withdrawn from Honduran territory. In spite of the brevity of this stalemated war, both sides paid dearly with an estimated 2,000 dead and tens of thousands injured and displaced.



IKONOS satellite images taken over much of the border in 2003 proved to be an invaluable addition to existing maps of the border area. The contour lines overlaid on this image were generated with the SRTM DTED® II elevation model. The points depicted in yellow are significant geographic features, including El Pital, the highest point along the border with an elevation of 2,732 meters above mean sea level.

It wasn't until 1980 that a general peace treaty was signed. In an attempt to finally resolve the boundary dispute, the treaty includes a general geographic description of the entire boundary and mechanisms to implement it. Under this treaty, 232 kilometers of the 375-kilometer international boundary were marked with boundary monuments, but the two sides were unable to reach agreement on the remaining six bolsones, or pockets of discord, along the border. They resorted to a provision in the treaty to submit their differences in 1986 to the International Court of Justice (ICJ) in The Hague, Netherlands. After thousands of hours of court proceedings stretching over several years, in 1992 the ICJ finally emitted their resolution: Case Concerning the Land, Island and Maritime Frontier Dispute (El Salvador-Honduras: Nicaragua Intervening).

A Problematic Resolution

Unfortunately, the ICJ resolution was not the end of the controversy. The ICJ carefully and thoroughly examined the legal, historical and technical arguments made by both sides and provided the litigants a resolution to the undefined bolsones by means of a textual description of the new boundary together with corresponding geographic coordinates of the principal points along the border and map attachments. The ICJ utilized all available geospatial information, i.e., maps and charts, to define the new boundary. However, as is customary for the ICJ, it did not perform any site inspections to make more precise measurements with survey instruments or exploit new overhead imagery. In the case of the bolsones, the ICJ utilized existing 1:50,000-scale topographic maps of the Defense Mapping Agency, an NGA predecessor organization, as the basis

for locating and determining geographic coordinates of the new boundary principal points cited in the resolution. Because of the inherent error in the identification and measurement from this map source (a 0.5 millimeter-pencil line on the 1:50,000-scale map = 25 meters on the ground), a new controversy arose when the two sides went to the field to implement the resolution. For example, the ICJ resolution would typically use a geographic feature like a mountaintop or origin of a stream as a principal point for the boundary, but the map-derived coordinates might differ as much as 250 meters or more from the Global Positioning System measurements made by the field parties. It is easy to interpret the intention of the ICJ in this case, i.e., utilize the geographic feature instead of the flawed geographic coordinates, but for the side that is perceived to lose territory by discounting the geographic coordinates, this is not so easy or simple a capitulation. Any such concession, real or perceived, would be political suicide in this highly charged issue so closely monitored by the media of both countries.

Along with representatives of the governments of El Salvador and Honduras, the author (center in blue baseball cap) discusses site inspection activities with the mayor of a local town (left in blue shirt).

Breaking the Logjam

In October 2002, Presidents Francisco Flores of El Salvador and Ricardo Maduro of Honduras broke the diplomatic impasse, initiating a political and financial commitment to complete the demarcation by May 2004. The two sides utilized an article of the 1980 General Peace Treaty to solicit the Pan American Institute of Geography and History, a special activity of the OAS, to name a third-party expert for the arbitration of technical differences. The Acting Secretary General of the OAS, Luigi Einaudi, a retired U.S. diplomat, contacted me and requested help. During the 1990s, I had participated as the U.S. technical representative to the border negotiations of the Ecuador-Peru peace process while Secretary General Einaudi was the U.S. Special Envoy to the peace negotiations. From June 2003 to June 2004, I made five trips to the border area with representatives of the governments of El Salvador and Honduras, and the OAS, to make on-site inspections of the points and line segments in dispute. Per the procedures in the General Peace Treaty, the third-party expert was to write binding resolutions for each of the points and line segments and to do so within a 30-day period after performing the site inspection. With these new resolutions in hand, the sides could then physically implement the remaining portions of the unresolved boundary by constructing and geo-locating concrete pillars along the boundary line.

Resolving the Differences

Resolving the delimitation of the boundary proved to be a physical and intellectual challenge. Much of the border is located deep within the mountains and is accessible only with 4x4 vehicles, by helicopters, with horses, or on foot. The site inspections involved walking the terrain, making GPS measurements, taking photographs, and, where appropriate, talking to local residents. The information gathered during the field visits was invaluable, but in some

cases, insufficient to make an informed decision. Many of the points and line segments in dispute required an in-depth analysis of the topography, hydrography, vegetation, lines of communication, populated places and geographic names juxtaposed with the legal and historical documents concerning the boundary. Critical to the geospatial analysis of the boundary area was access to commercial satellite imagery (NGA purchased IKONOS imagery over almost the entire border), the Shuttle Radar Topography Mission Digital Terrain Elevation Data (SRTM DTED® Level II with a posting every arc second), and other ancillary data and services available within NGA. These data sets and services were used to create unique image products and visualizations for use in the decision-making process and as graphics for the written resolutions submitted to the two sides.

The definitive resolution of the El-Salvador-Honduras boundary is an important step in the pacification and reunification of the five independent republics of Central America.

One More Point to Go

Of the total of 16 points and line segments on the border that were subject to this arbitration, all but one point have been marked with a monument. This one remaining point, located in the small rural community of Santa Rosa, was the most technically challenging to resolve, and has proved to be controversial to implement because of its location in the center of this largely Salvadoran community. The ICJ settled on this location largely because of an 1839 survey that established the boundary of public lands separating two indigenous communities. Both governments have done an admirable job of explaining to the people residing near the border that the new international boundary in no way changes the existing private property lines or legal rights of the residents to remain citizens of their country of origin. In my opinion, this one remaining point will be implemented just as soon as the political climate is right.

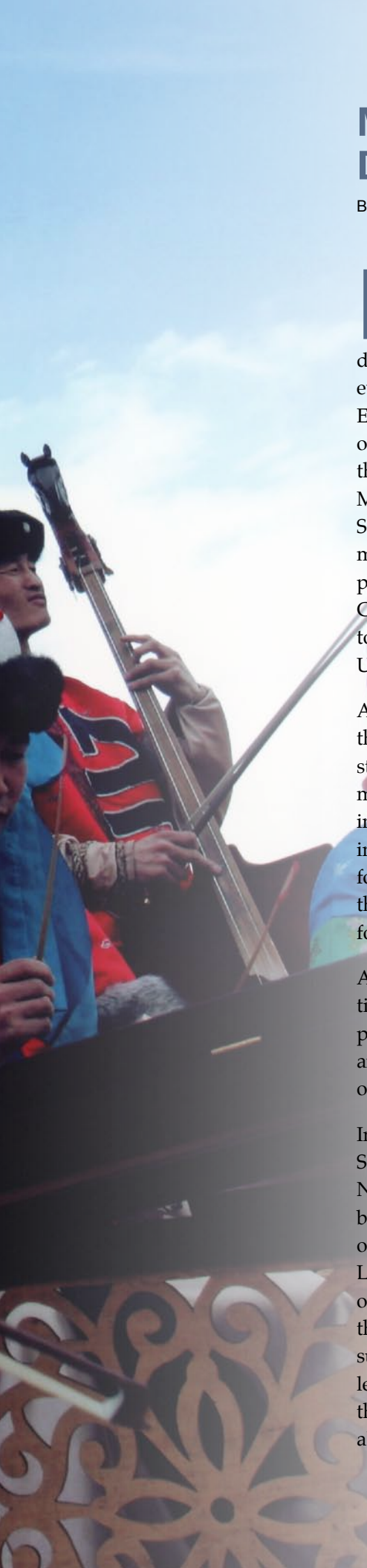
Conclusion

The definitive resolution of the El Salvador–Honduras boundary is an important step in the pacification and reunification of the five independent republics of Central America. The governments of these two countries have put aside historical differences to peacefully seek a resolution through the International Court of Justice and the Organization of American States. The role of NGA in the final resolution should not be understated. NGA's unique access to commercial satellite imagery, digital elevation models, mapping information, advanced geospatial analysis and ancillary data provided a base of geospatial knowledge of evident breadth and depth. The geospatial knowledge developed for this effort was an invaluable tool for the arbiter to resolve the placement of the boundary in an unbiased manner consistent with the intentions of the ICJ and the geographic realities on the ground. NGA once again demonstrated the power of geospatial analysis. I am humbled to have been a part of this historic and important accomplishment.

The Mongolian Armed Forces brought out musicians to play folk- style music native to Mongolia during the cultural day April 27 during exercise Khaan Quest '05.
Photo by Gunnery Sgt. Timothy A. Streaty

Mongolia and NGA Collaborate to Develop New GEOINT

By Steve Kenyon



Mongolia is a country with a rich history. In the 1200s Genghis Khan and the Mongols swept down from the Gobi Desert, conquering everything between Beijing and Eastern Europe. Shrouded in mystery during much of the last 800 years and isolated from the West under the communist umbrella, Mongolia emerged after the fall of the Soviet Union as a democracy. While maintaining important economic and political ties with its powerful neighbors, China and Russia, Mongolia was eager to develop new partnerships with the United States.

As part of their efforts to modernize, the Mongolians realized they needed a strong geodetic foundation for accurate mapping, land valuation and geographic information systems they were developing. To achieve a state-of-the-art geodetic foundation, the government reached out to the United States and the experts at NGA for assistance.

At the same time, NGA sought collaboration because of the unique and strategic position that Mongolia has in the world and due to the simple fact that we had little or no GEOINT for the country.

In 1999, NGA's Geospatial Intelligence Sciences Office (SN), in coordination with NGA's Office of International and Policy, began discussions with representatives of the Mongolian Administration of Land Affairs, Geodesy and Cartography on improving the Mongolian portion of the Earth's geoid. The vertical reference surface that closely approximates mean sea level over land, the Earth's geoid provides the reference surface for the heights of all natural and manmade features being mapped. From these initial meetings, it was clear that other GEOINT opportunities were possible, and NGA quickly added other projects of mutual interest to our discussions with Mongolia.

SRTM Collaboration

With the Shuttle Radar Topography Mission (SRTM) collecting elevation data in February 2000, Mongolia agreed to participate with us in conducting a Global Positioning Sytem (GPS) transect over their country for the calibration and validation of the data. We developed an agreement with Mongolia for them to survey their primary east-west and north-south road network. Little did we know that the paved roads quickly gave way to dirt and gravel just outside the capital of Ulaanbaatar, and that in the western and southern parts of the country they were barely passable for much of the year. The Mongolians, who were initially trained by SN, did a superb job in the fall and winter of 2000 conducting the survey, and the images of them in the remote Gobi Desert traversing ice-covered roads were not only memorable but also showed their dedication to the project.

Mongolia provided the precise and accurate coordinates collected from these surveys to our partners at NASA's Jet Propulsion Laboratory, who found them invaluable in validating the SRTM data over Mongolia. From the Mongolian perspective, the survey provided a firsthand assessment of the quality of their elevation data and its value in developing a new geoid model for their country. This survey—the only one performed in Asia in support of SRTM—was a major success and paved the way for more ambitious geodetic projects to be planned.

Building a Better Geoid

In 2004 NGA and its Mongolian counterpart signed a basic exchange and cooperative agreement to serve as a catalyst for additional GEOINT projects between our two countries. One of the important appendices under the agreement provided for the acquisition of airborne gravity over Mongolia. The development of a highly accurate geoid model for Mongolia depended on detailed gravity and elevation data.

With mountainous terrain covering a large part of the country, combined with a very limited road network, the collection of gravity using traditional ground measuring devices was a difficult and forbidding proposition. The gravity database available for Mongolia was either void or very sparse due to the impenetrability of the country, and airborne gravity provided the ideal solution. Gravity collected by airborne techniques is very accurate. Because flights can be conducted just above the terrain level, the shorter wavelengths of gravity can be measured. In contrast, while operating from space, only the longest wavelengths of gravity can be observed.

The two-year airborne gravity survey program that resulted from the agreement began in western Mongolia. Track spacing of 18 kilometers enabled the production of an accurate 5 by 5-minute gravity anomaly. A gravity anomaly is a measure of how the actual gravity field varies from an idealized model of the Earth. The survey covered eastern and southern Mongolia the following year with the same 18-kilometer spacing.

To complement the aero gravity and ensure it is properly referenced, NGA conducted an absolute-gravity survey in the summer and fall of 2004, covering three geographically distinct sites throughout the country. The absolute gravity survey was another essential step in facilitating Mongolia's transition to World Geodetic System 84 (WGS 84), the global coordinate frame provided by NGA for the GPS.

The aero-gravity and absolute-gravity projects are fundamental to NGA's efforts

A Marine tactics instructor teaches Marines and Mongolian soldiers proper rifle-handling techniques May 20 during Khaan Quest '05. Khaan Quest '05 is a Bilateral peacekeeping exercise conducted at the Five Hills training area in Mongolia. This exercise is focused on improving the Mongolian Armed Forces effectiveness and interoperability with the United States.

Photo by Pfc. T. J. Kaemmerer

in maintaining WGS 84 and leading the way with improved GEOINT support to our customers. The gravity data is extremely important for the upcoming Earth Gravity Model 2006, an integral part of WGS 84 and our support of precision inertial navigation and low-earth orbit modeling.

Mongolia has benefited from the aero- and absolute-gravity projects because now the country will be able to produce an extremely accurate geoid model, which will make possible the proper vertical referencing of the country's feature data. Because Mongolia supported the 2000 SRTM, which gathered global elevation data, the Mongolians received Digital Terrain Elevation Data (DTED®) Level 2 data, enabling them to produce GEOINT and mapping products to the highest accuracy possible.

Air Navigation Data

As part of their cooperative efforts with NGA, the Mongolians have also provided their current Airfield Flight Information Publications. This has greatly assisted NGA's Aeronautical Division in its understanding of airfield operations in the country. Future projects in geodesy, geographic names and other related GEOINT activities are being coordinated with the Mongolians as NGA continues partnering with this new strategic partner in Central Asia.

A Spectacular Land

Besides a rich history, Mongolia has scenery that is nothing short of spectacular.

Western Mongolia is extremely mountainous and remote. Operational bases for the airborne gravity survey were established in the small towns of Altai and Khovd. Many of western Mongolia's inhabitants are nomads, who live in tents (*gers*) and move over the land with their goats and sheep as their ancestors did. It's a land with no fences and blue sky—similar to our American West in the early 1800s.

Eastern and southern Mongolia are partly covered by the remote Gobi Desert, the land visited by dinosaur hunters like Roy Chapman Andrews. He led expeditions to this region during the 1920s for the American Museum of Natural History.

Language Lessons

NGA Leads International Standards Effort

By Dr. Clifford Kottman

Est-ce correct? Est-ce correct!? Veuillez pardoner mes fabilesses en anglais!"

Likely, fewer than 2 percent of you know what that means. If we had paid attention to, or better yet retained, Madame Marie's seventh-grade French lessons, we would know I am seeking clarification from you: "Is this correct? Is this correct?" And then I am apologizing for my poor English.

It is impossible to communicate efficiently without a common language understood by both sender and receiver. The same thing is true when the message to be shared is technical in character. International commerce in geospatial information needs to be enabled and facilitated by a single geospatial language. NGA plays a leadership role in the development of just such a language to transmit geospatial intelligence (GEOINT).

Ever seeking efficient ways to provide relevant and accurate data to our customers, NGA has gone beyond our borders to help develop a common, international language for expressing and sharing GEOINT. The Agency, with help from its allies and coalition partners, is leading a massive international movement to establish, sustain and employ a common architecture until it flourishes as a result of its own intrinsic value.

A Language for GEOINT

Sometimes we forget how easy it is to be misunderstood. Misunderstandings stem from breakdowns in the essential, but subtle, layers and complex internal structures of the language carrying the message. Some of the structures of a natural (human) language are phonetics, lexicography, syntax, semantics, linguistics and idiom.

A language that models and transports digital geospatial intelligence (GEOINT) must provide similar elemental structures, for example:

- grids
- imagery
- metadata
- geometry schema
- topology
- dynamic features
- observations
- basic data types
- direction
- topology schema
- class roots and hierarchy
- feature schema
- coordinate reference systems
- temporal constructs
- coverages
- values and units
- graphical styling
- location

The sender and the receiver of digital GEOINT must craft agreements on all these structures and more.

Forming international consensus and implementation-ready specifications and standards for each of the structures listed above is at the heart of the standardization business. This is the environment in which the National Center for Geospatial Intelligence Standards at NGA has contributed. The Center's work is aimed at assuring that emerging international standards support the stringent requirements associated with sharing GEOINT without any information breakdowns.

Geography Markup Language

Since 1994 the International Organization for Standardization (ISO) and Open Geospatial Consortium have worked

together to develop common standards for geographical concepts and specifications that provide access to and manipulation of geographic information. NGA and the Defense Mapping Agency, a predecessor organization, have been involved in these efforts from the start. Canada and the United Kingdom have been particularly helpful and also took on leadership responsibilities in these two organizations.

The work of the ISO and Open Geospatial Consortium has come together in a common, international language for expressing and sharing geospatial information: Geography Markup Language, or GML. In providing a standard for exchanging geographic features, GML uses Extensible Markup Language (XML), which provides a simple, very flexible format adopted by the ISO for a variety of applications.

GML includes an extensive set of XML schemas for expressing geometries like points, lines and polygons. The GML specification includes rules for incorporating these geometries into GML feature types that represent real-world objects. In this way, GML provides the building blocks for representing features, properties and geometries.

While GML includes a set of predefined geometry types, it does not contain specific real-world geographic entities. For example, you will not find a road or runway defined in GML. Instead, GML provides a standard framework that can be used to define a road or runway in a consistent way within a specific user community. By using the GML framework, specific geographic entities like the road and runway can be generically interpreted by any tool that can interpret GML.

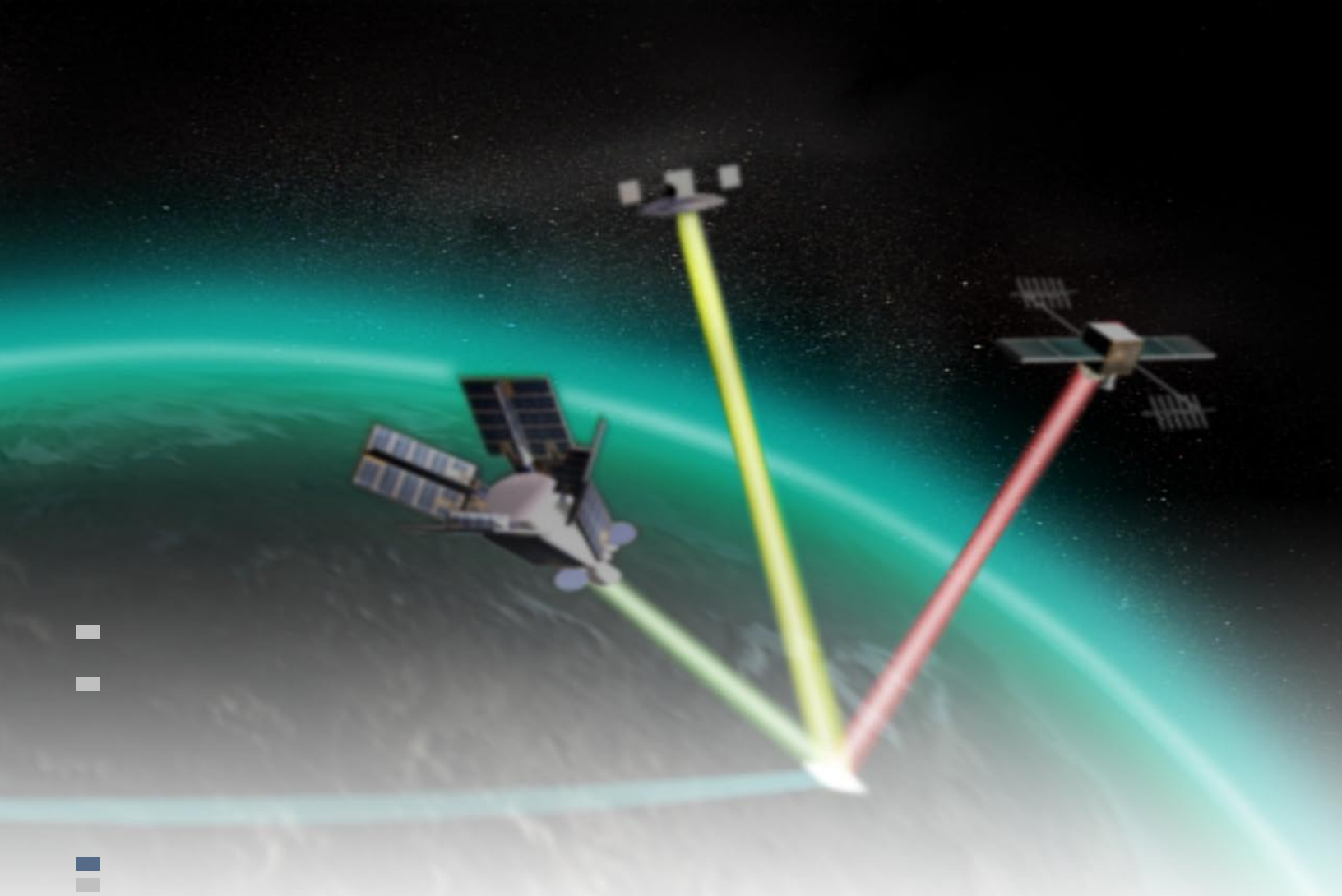
NGA's Leadership Role

Through membership in international organizations and direct funding of special projects, NGA provided timely and substantial leadership in the sequence of events that has led to the creation of GML. Additional leadership has been provided through expert NGA staff members who volunteer to serve (often as chairs of working groups) in the drafting, authoring, reviewing, implementing, testing, rationalizing and improving the GML suite of standards.

In many ways, this leadership has been just in time. Today's marketplace is increasingly global in character, and broad international consensus is a necessary ingredient for any candidate standard to win a share of the market. Internationalization of GML refers to the elements of its design that enable it to be adapted to various languages and regions without engineering changes. The internationalization of GML has satisfied a major NGA requirement.

The first two versions of GML supported the exchange of features with simple geometry, such as points, lines and polygons. With input from NGA, the latest version supports the full variety of geometric representations, while providing for topological structure (explicit definitions of how digital map features are related) and descriptions of coordinate reference systems. This means that complex objects such as "all the legal driving lanes in all the interstate highways in Los Angeles County and all the connections between them" can now be unambiguously modeled and analyzed. Version 3 is now undergoing further development as an international standard, to be published during 2006. The effort involves 28 participating countries, 30 observing nations and dozens of liaisons.

NGA is also sponsoring an effort to harmonize and integrate GML with the Aeronautical Information Exchange Model (AIXM). Based on standards of the International Civil Aviation Organization, AIXM uses the XML format and contains a custom model for representing geographical features.



Satellite imagery is one of the many types of GEOINT NGA has helped standardize.

Multinational Applications

The Digital Geospatial Information Working Group (DGIWG), a multinational body, has jumped on the standards bandwagon. The result is a powerful alliance in which the sharing of GEOINT is enabled. DGIWG is responsible for geospatial standardization in the defense organizations of member nations:

Belgium	Netherlands
Canada	Norway
Czech Republic	Portugal
Denmark	Spain
France	Sweden
Germany	Turkey
Greece	United Kingdom
Italy	United States

The group addresses requirements these nations have for access to compatible geospatial information for joint operations. It supports requirements of NATO and other alliances that member nations participate in, including U.N.-sanctioned peacekeeping. The United States has served as the vice chair and technology leader of DGIWG since the group's establishment in 1983.

For over three decades, NGA and its predecessor organizations have been seeking a language with which to model and transport geospatial information. Thanks to NGA and our foreign partners, that quest is now largely over. And GML is the common, understood language of GEOINT.

19 Nations Collaborate to Map the World in Digits

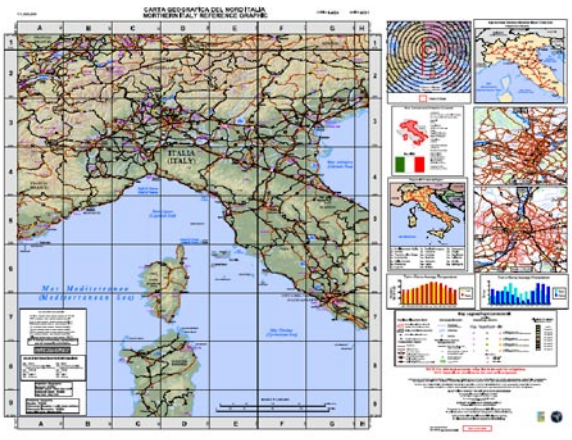
By Damien Kerr

Last fall's tragic earthquake in Pakistan underscored the value and importance of NGA's Vector Map Level 1 (VMap1) program. Around the world, geospatial analysts turned to this standard product because it provides the best available global medium-scale vector data.

The VMap1 program is a worldwide effort to collect vector data—digitized points, lines and polygons used to represent features on Earth.

With the delivery of the final compact disk (CD) in December, NGA and its international co-producers and contractors achieved worldwide coverage of VMap1, culminating a successful 12-year effort. Credit for completion of this dynamic dataset needs to be shared with our international co-producers, with contract partners and within NGA. The only worldwide product of its kind, VMap1 has set the standard and moved mapping into the digital age.

VMap1 CD 84 was used to produce this Northern Italy Reference Graphic in support of the 2006 Winter Olympics in Turin, Italy. One of 19 international co-producers, Italy produced the CD, which is one of 234 representing near- global coverage.



Meets GIS Needs

The VMap1 program responded to the needs of the geospatial industry in the early 1990s as it shifted from the production of static paper maps to a dynamic data representation that enabled direct digital input to geographic information systems.

Vector data can be used for high-level analysis and cartographic products. At a scale equivalent to a 1:250,000-scale hardcopy map, VMap1 is separated into thematic layers, or coverages, with all the data topologically structured (explicitly related). The topological (smart) data structure and choice of coverages provide users capabilities for analysis that hardcopy maps lack.

Each coverage contains metadata describing the features in that thematic layer. Cross-tile topology is also maintained. Data coverages are:

boundaries	elevation
hydrography	industry
physiography	population
transportation	utilities
vegetation	data quality
tile reference	library reference

VMap data is tiled in cells one degree square in area. A 1-degree cell is about 9,200 square kilometers (3,600 square nautical miles) at the equator, diminishing slightly in size at higher latitudes north and south of the equator. Most of the sources used to produce VMap1 were scanned paper maps.

VMap1 has provided the groundwork for future NGA GIS data. Capitalizing on the co-production effort, NGA initialized its Geospatial Intelligence Foundation Database (GIFD) with VMap1. The data has been used to support the global war on terrorism.

Features of VMap1 are coded and attributed according to the Feature Attribute Coding Catalogue (International Standard). The data is generated in Vector Product Format (VPF) according to Military Standard 2407. The data is then distributed on CD through the Defense Logistics Agency, through internal networks and the NGA World Wide Web site (for portions that are

releasable to the public), by co-producers and through the GIFD.

While VMap1 data is unclassified, it is released in one of three categories: for limited distribution, official use only and public release.

Co-Production Group

To achieve global coverage of vector data, NGA employed a three-tiered production approach: in-house, outsourced and co-production.

The Vector Map Co-Production Working Group (VaCWG) is a multinational body responsible for the production and provision of VMap1 data and products. The group has 19 member nations:

Australia
Belgium
Canada
Czech Republic
Denmark
France
Germany
Greece
Italy
Netherlands
New Zealand
Norway
Poland
Portugal
Spain
Sweden
Turkey
United Kingdom
United States

Each co-producer was challenged to contribute, at a minimum, two VMap1 CDs to the program. The entire program totals 234 CDs representing near global coverage. All members have free access to the data over the entire production area.

Some of VMap1 data is being updated and enhanced. A few members of the VaCWG will issue new editions.

NGA and our international partners are receiving an increasing number of requests for VMap1 from bodies such as NATO and the United Nations, European Union and African Union. Because of its international standards, quality and consistency, VMap1 data is also used in a large number of defense systems, as well as for security, planning and recovery operations. United Kingdom officials stated that they use VMap1 as a planning and operational tool, and the Royal Air Force uses the data in flight simulators. German officials stated that they use VMap1 in different command and control systems.

NGA, our contractors and our international partners again are making a difference in the world. Italy, which produced VMap CD 84, is using it as a source for graphics in preparations for the 2006 Winter Olympics in Turin. CD 110 is being used for relief operations in Pakistan. In December 2004, 127 copies of CD 170, produced by New Zealand, were delivered to customers and vendors for tsunami relief operations.

What's Next

Although the initial population of VMap1 data has concluded, the co-production effort continues. NGA and our international partners have formed the Multinational Geospatial Co-Production Program (MGCP). Chaired by NGA's Marzio Dellagnello, who played a major role in the VMAP co-production effort, the MGCP is an effort to continue with the fantastic success forged by VMap1 and the VaCWG.

The MGCP will produce a series of higher resolution vector data sets and will enthusiastically increase the number of membership nations. While the VaCWG had 19 nations participating, the MGCP will have 28. The MGCP effort hopes to deliver approximately 3,000 one-degree vector data cells at a density of 1:50,000 to 1:100,000 by 2011.

With the completion of VMap1, the international geospatial community has taken a giant step forward. Now the world has a tailorable, worldwide base of information from which to draw at a moment's notice. Once again, NGA, our contractors and co-producers are making a difference around the world.

NGA's International Activities Involve Many Nations

By Mark Binfield

No one would be surprised that NGA works closely with partners in Australia, Canada or Great Britain. Few would be surprised to find us working with traditional NATO allies like Germany or Turkey. But actually, in its mission NGA deals with many countries outside this mold.

NGA trades maps, charts and geospatial data with over 100 foreign organizations through a network of agreements. Needing data on areas around the world, NGA is working to expand this network. Moving beyond traditional allies allows NGA access to more data and helps the U.S. government build positive relationships with new nations. It also helps in providing support to the increasingly broad coalitions that the U.S. military works with today.

This article highlights the breadth of NGA's international activities with a survey of some of the work we've done with less obvious partners. Rather than a comprehensive review, this is a sampling of the variety of projects and nations with which NGA is involved.

Eastern Europe

In 1990 Eastern Europe lay behind the Iron Curtain. The U.S. Intelligence Community had an interest in the region, but only as a target; it was important to keep an eye on the Soviet and Eastern Bloc military forces based there. Less than two decades later, the picture has changed. Some of those nations are now members of NATO. Others are part of NATO's Partnership for Peace, a project to encourage trust and cooperation between NATO and non-NATO countries.

NGA now has partnerships with most of the countries of Eastern Europe, both former Soviet Union and former Eastern Bloc. There are already signed agreements with Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland and Romania.

When Eastern European countries deployed troops to Haiti, Afghanistan, Bosnia, Kosovo and other locations around the world, NGA stepped forward to provide them with needed geospatial information. We've also assisted with airfield surveys, flood control, border delineation talks and environmental cleanup efforts. Farther south, NGA has supported humanitarian de-mining efforts in Azerbaijan.

The agreements aren't one-way streets. Before visits by President Bush to Latvia and Slovakia, each of these countries provided the United States with maps and geospatial data, which NGA and the Secret Service used in support of the visits. NGA routinely receives nautical charts, city maps, topographic maps and aeronautical charts from its partners in Eastern Europe.

Asia

The United States has a number of agreements in place in Asia and is active in supporting allies in the region. We have a robust agreement with the Republic of Korea. A new mapping and charting agreement with Mongolia was signed in 2004. We also exchange aeronautical data with many countries in the region.

One of NGA's closer partners in the Asia-Pacific region is Thailand. In the 1990s the Royal Thai Survey Department (RTSD)

sought U.S. assistance in re-mapping the entire country of Thailand. The RTSD provided $30 million, ancillary maps, aerial photography and ground survey data, while NGA managed the project, participated in production and data collection and arranged for U.S. contractors to carry the bulk of the production workload. This historic mapping effort was completed in 2003. Since then, NGA has been helping the Thais bolster their mapping capability by providing them with improved technology to process commercial satellite imagery. Today the Thais are able to map regionally denied areas with the following system capabilities: commercial imagery ingest, updating the database of a geographic information system, and creation of hard copy maps. RTSD supplies NGA with revised products on a regular basis.

NGA trades maps, charts and geospatial data with over 100 foreign organizations through a network of agreements.

NGA also deals with some unlikely countries in Asia. For example, the U.S. Geological Survey (USGS) has a technical exchange agreement with the Bureau of Surveying and Mapping of the People's Republic of China. NGA is a participant with USGS on this agreement. Customers of NGA products include North Korea and Vietnam, both of which buy aeronautical safety of navigation data by subscription.

Latin America

The United States has been cooperating with the countries of Latin America on mapping issues since shortly after World War II. Through the Inter-American Geodetic Survey, the Army Map Service (an NGA predecessor) helped set up mapping organizations in many Latin American nations. The United States also provided cartographic training to Latin American personnel through a school in Panama.

Because of this legacy, some of NGA's most robust relationships are in Latin America. In fact, we have formal geospatial sharing agreements with every South American country but Brazil. We also participate in the Pan American Institute of Geography and History (PAIGH), which is part of the Organization of American States.

One of NGA's most significant contributions in Latin America was our assistance in ending the border dispute between Peru and Ecuador. This border had been unclear since the mid-1800s and actively disputed since 1942. The dispute was partly fueled by disagreement over the location of watershed boundaries in this remote region. The countries signed a historic agreement on the demarcation of their border in the spring of 1999, but to actually map out this border, negotiators turned to NGA. With oversight from both sides, NGA produced accurate maps of the watershed boundaries, fixing the location of the new border.

NGA has benefited from its Latin American relationships, too. South American nations provided valuable assistance to the Shuttle Radar Topography Mission, a mapping project recently completed by NASA and NGA. Control points provided by these countries were used in calibrating the data gathered over South America. NGA also engages in co-production with many countries in Latin America.

We are still working on ways to expand our partnerships, including new projects with the PAIGH.

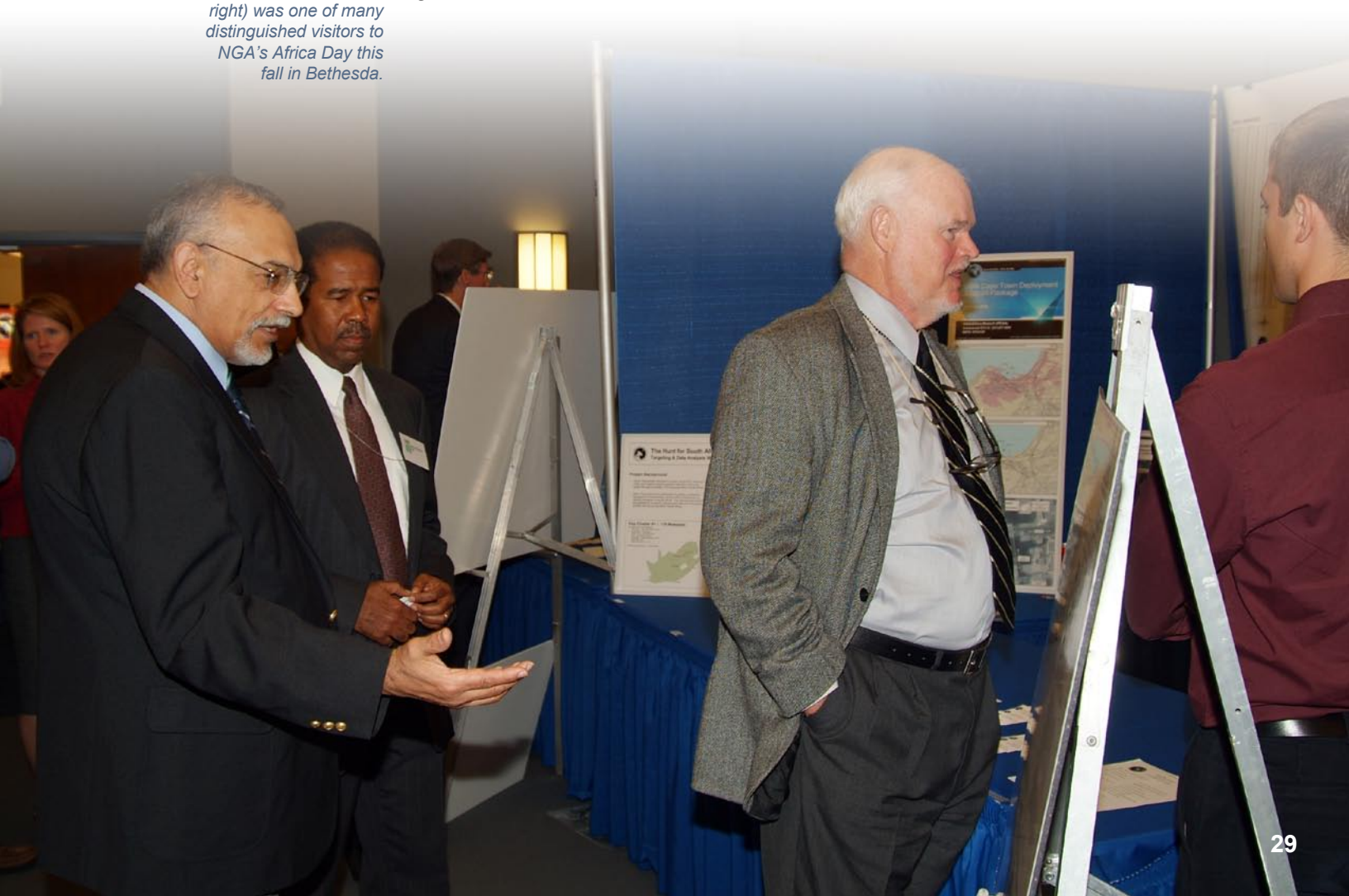
Africa Day Continues Trend of Successful NGA Regional Conferences

By Matt Reiner

A continent that holds much promise received thorough coverage at NGA's first annual Africa Day this fall in Bethesda. Over a dozen Intelligence Community officials spoke on Africa's political, economic and military issues, giving analysts in attendance a deeper understanding of the region. In addition, several NGA booths were on display to demonstrate NGA regional and functional analytic efforts pertaining to Africa.

NGA Deputy Director Joanne Isham called the event "an opportunity for analysts to step back and look at the rapidly changing Africa" and mentioned several NGA success stories, including analysts' work on assessing the violence in the Darfur region of Western Sudan. Isham, along with Ambassador Robert Houdek, the National Intelligence Officer for Africa, emphasized that two new challenges affecting the region, terrorism and weapons proliferation, give it added importance for analysts.

Africa Day continued a trend of NGA hosting regional conferences—which includes the previous Russia Day and China Day—designed to strengthen expertise and stimulate communication and collaboration between experts.



Ambassador Robert Houdek, the National Intelligence Officer for Africa (second from right) was one of many distinguished visitors to NGA's Africa Day this fall in Bethesda.

Germany Expands Co-Production Capabilities

By David Fontenot and Kevin Firmin

Besides having a reputation for well-engineered cars, delicious beer and a beautiful countryside, Germany is regarded as a major player in the geospatial-intelligence (GEOINT) community. This is evident in the agreement between the Bundeswehr Geoinformation Office (BGIO) and NGA for the collection of digital high-resolution data and hard-copy product finishing. The agreement represents a huge burden sharing of each nation's requirements for worldwide GEOINT data and products.

Officially signed on Sept. 15, 2004, the agreement promotes maximum geospatial interoperability between BGIO and NGA by providing for bilateral co-production and the exchange and release of geospatial data and information.

As part of the partnership, BGIO now prints and provides operational stock directly to the U.S. Defense Logistics Agency (DLA) for distribution. At the same time, the BGIO sends digital data to NGA for inclusion in NGA's Geospatial Intelligence Feature Database (GIFD).

BGIO is the sole provider of geospatial information to the German Military Forces. The organization maintains a worldwide *geodatabase* that it uses to produce a range of products, including Image City Maps, Topographic Line Maps, aeronautical products, digital data sets and meteorological planning and forecast materials.

"The BGIO-NGA partnership has yielded significant benefits for both nations," said Jack Hild, the Business Executive for NGA's Source Operations and Management Directorate. "BGIO has sent a strong signal that they intend to be an influential member of the global geospatial enterprise."

History of Cooperation

The exchange of topographic products between BGIO and NGA dates back to 1994.

Germany's growing role in the GEOINT community became more evident in early 2000. The Director of the BGIO then decided that Germany needed to expand its role as provider of international geospatial data. To accomplish this, the BGIO decided to build a new production facility in Euskirchen, Germany.

While developing plans for this facility, BGIO established a testbed to develop and test digital production processes with support from NGA. Prototyping officially began at the testbed facility in February 2001 as the prelude to full-scale co-production. At the same time NGA expanded its geospatial co-production relationship with BGIO, beginning with the joint production of two feature data cells and six 1:50,000-scale Topographic Line Maps within the test-bed facility.

With the completion of the new Euskirchen facility last August, Germany has tripled the number of hard- and softcopy Image City Maps and Topographic Line Maps it plans to co-produce through fiscal 2008.

BGIO's new production facility in Euskirchen, Germany was completed last August. The facility co-produces hard and softcopy Image City Maps and Topographic Line Maps.

At the dedication ceremony of the new production facility last August, BGIO Director Col. Walter Schmidt-Bleker praised the decision of BGIO to "contribute to burden-sharing and to shape the ground for the production of digital high-resolution geospatial data." The partnership with NGA is "another pillar to the bridge across the North Atlantic," he said.

Thanks to the leaders of BGIO and NGA, the co-production program shows great potential for continued gains and will only grow with Germany's increased co-production capability. The agreement helps utilize each organization's strengths and serves as a model of cooperation throughout the global intelligence community.

A Tie of Special Significance

Over the past 15 years the threat to the Free World has changed, shifting away from a, by and large, calculable military threat towards terrorism and the proliferation of weapons of mass destruction. As a result of this development the question cropped up of how to cope with this multi-faceted threat.

A prerequisite is to gain information dominance and translate that into an advantage for military action. In doing so, it turns out to be a problem to filter and evaluate countless and versatile information, a challenge that can hardly be accomplished by one nation alone.

Against this backdrop and after intensive consultations with NGA, the Bundeswehr Geoinformation Office (BGIO) decided to contribute to the burden-sharing and to shape the ground for the production of digital high-resolution geospatial data. That way, the BGIO wholeheartedly paid tribute to the special significance of the transatlantic tie and added another pillar to the bridge across the North Atlantic.

—Excerpt of remarks by the Director of the Bundeswehr Geoinformation Office, Col. Walter Schmidt-Bleker, at the dedication of a new production facility in Euskirchen, Germany.

Moldova and NGA Host Partnership for Peace Symposium

By Kirk Tozer

The Moldovan Ministry of Defense and NGA hosted the fourth annual NATO Partnership for Peace (PfP) Geospatial Symposium and Technology Exposition in the Moldovan capitol, Chisinau, this past May. "GIS Support to Multinational Peacekeeping" was the theme of the two-day symposium. Over 120 geospatial professionals from 17 NATO and PfP countries participated.

Moldovan Minister of Defense Valeriu Plesca, U.S. Ambassador to Moldova Heather Hodges and NGA Director retired Air Force Lt. Gen. James R. Clapper Jr. addressed those attending. This year's symposium was noteworthy in that it was the first year that representatives from the Central Asian republics of Kazakhstan, Kyrgyzstan and Turkmenistan took part.

The Defense Minister spoke about the comprehensive restructuring and modernization of the National Army of the Republic of Moldova. Achieving military and geographic topo-geodetic interoperability is vital, he said. This is one of Moldova's major goals, which will better allow the country to cooperate and accomplish coalition missions in today's risky and challenging environment. Today's military forces must fill a broad range of missions in greatly diverse geographic areas, and therefore, correct formats and accurate geographic data are imperative, he added.

Over the past two years, Moldova has greatly expanded its contribution to international peacekeeping operations. The National Army has military units and specialists in Chechnya, Georgia, Kosovo and Macedonia supporting the Office of Security and Cooperation in Europe (OSCE). Moldova is involved in Iraq and Bosnia and Herzegovina. Its army is also supporting U.N. missions in Ivory Coast, Liberia and Sudan. All of these operations require GEOINT, and Moldova's contribution to their success is critical. To this end, the partnership between Moldova and NGA is also very important.

The Ambassador said the NGA Director's visit, combined with the visit of Secretary of Defense Donald Rumsfeld and other high-ranking U.S. officials, is "proof of a solid relationship." It's a relationship "based on common values of democracy and civilian control," she noted.

"Support to Multinational Peacekeeping Efforts"—the theme of the symposium—is "critically important work," she noted. "The United States sincerely appreciates the efforts that many of the countries present at the conference have been making in helping to shoulder the burden of maintaining peace and stability in the world."

NGA's Director said he had witnessed the high energy and camaraderie that exist within the international geospatial community at last year's symposium in Riga, Latvia. He was looking forward to advancing the partnership with Moldova and continued collaboration with the international community.

GIS applications have tremendous potential to increase a large variety of security and cooperation activities, he said. These include:

- Improving coalition joint service operations in the global fight against terrorism,

- Supporting peacekeeping operations in regional conflicts,
- Assisting with treaty-monitoring activities,
- Improving homeland security, emergency preparedness and disaster responsiveness, and
- Improving search and rescue.

Last year seven nations joined NATO. Clapper encouraged new NATO partners to be attentive to the presentations from those partners who are presently working with NGA to advance GEOINT for all. He added that NGA is committed to increasing the Agency's collaboration and sharing with its allies.

Lieutenant Col. Alexandru Cebanu, Chief of the Moldovan Topographic Service, provided an enlightening presentation on geographic support to U.N. peacekeeping missions. Data for geographic information systems, and GIS hardware and software, is limited, he noted. There is a need for adequately trained GIS staff. GIS interoperability remains the toughest challenge when coordinating the participation of multinational armed forces and non-governmental agencies supporting any peacekeeping mission, he said. His presentation pointed to opportunities for further collaboration among international partners.

NGA's Marzio Dellagnello briefed on the Multinational Geospatial Co-production Program (MGCP) he chairs, as well as the International Geospatial Warehouse. The goal of the MGCP is worldwide coverage of high-resolution vector feature data. It provides for standardized collection of geospatial features and coordination of national production strategies.

The continuing expansion of participation in the MGCP is a major sign of its success, Dellagnello said. Global coverage in medium-resolution vector data was completed last fall through a similar multinational effort. (See the article on the completion of VMAP1, "19 Nations Collaborate to Map the World in Digits.")

The new NATO members took advantage of the symposium's unique opportunities to further improve and strengthen their relationships within the ever-expanding global geospatial community.

Several PfP nations briefed their latest GEOINT developments and capabilities. Their accomplishments helped to improve the understanding of many of the partner nations. All see the value of GEOINT, and bilateral and multinational relationships continue to emerge.

NGA employees examine a 1:250,000-scale model of Moldova on display in Bethesda. This model is one of the five NGA produced.

U.S. Ambassador to Moldova Presents Model of Country in 3-D

By Philip Hanley

The Department of State, Department of Defense and NGA collaborated to produce a three-dimensional terrain model of Moldova.

U.S. Ambassador Heather Hodges presented the model, produced in NGA's 3-D Model Production Facility, to President Vladimir Voronin of Moldova Oct. 5 as a symbol of goodwill and cooperation between our two countries. The presentation made the evening news across Moldova.

NGA produced the model after the U.S. Ambassador approached NGA Director retired Air Force Lt. Gen. James R. Clapper Jr. during the Partnership for Peace (PfP) Geospatial Symposium in Chisinau, the Moldovan capital. The NGA Support Team at the Department of State and Defense Attaché Office in Chisinau subsequently assisted in conveying and clarifying the Ambassador's request.

Clapper tasked the Eurasia-Africa Office to produce the model. Several geospatial analysts evaluated and compiled foundation data such as Landsat imagery, Digital Terrain Elevation Data® and map feature data to support the construction of the 3-D model. At the same time, NGA's Office of International and Policy cleared the compiled data for release.

Production of a solid polyurethane relief model of Moldova, like those used for briefings and operational planning, was the responsibility of NGA's 3-D Model Production Facility. To shape the highly accurate terrain model, the Facility used the elevation data and imagery the analysts compiled in a proprietary software package that guided specialized milling equipment. (The model exaggerates the actual elevation seven times to enhance the 3-D vertical effect.) After the application of five coats of primer, a custom printing machine flew four inkjet print heads over the surface of the model, printing imagery and vector (feature) data in full color. A lacquer finish and custom frame completed the model's construction.

The Facility produced five 1:250,000-scale models measuring 47 by 57 inches each. NGA sent three of them to the U.S. Embassy in Chisinau. The Embassy presented a second model to the Moldovan Ministry of Defense, and a third model is on display at the embassy.

The remaining two models are on display at U.S. Department of State headquarters in Washington, D.C. and at NGA in Bethesda, Md., on the first floor of Roberdeau Hall.

The 3-D relief model of Moldova is proof of NGA's commitment to its customers' varied needs. Presentation of the model to the President of Moldova was "a pleasant experience," said Army Lt. Col. Richard M. Reyno, Defense and Army Attaché in Chisinau. "I believe it contributed to our relations in a positive way ... You've [NGA] made DoD look good."

NGA's College Welcomes International Students

By Capt. Preston Wallech

This was the best training we've received from a foreign country in a long time. Superb training, please come again and give us more."

These words were spoken by the commanding general of a foreign unit that recently received training as a group from the Defense Geospatial-Intelligence School (DGS), part of the National Geospatial-Intelligence College (NGC) of NGA. Soldiers, sailors, airmen, Marines and civilians in the Department of Defense (DoD) expect the school to deliver timely and relevant training. What you may not know is that DGS has a long history of providing tailored entry-level and advanced instruction to America's partners.

Over the past three years, NGA civilian and military instructors have taught over 250 international students, both civilian and military. Most travel the globe to the NGC campus at Fort Belvoir, Va. However, DGS instructors also deploy overseas to conduct training for host units. This proud heritage will only increase as the United States is involved in more coalition operations.

DGS instructors have recent operational experience, which enables training to mirror the work environment in task and function.

"We have instructors who complete their assignment and return to their respective services as GEOINT experts," said DGS Commandant Army Col. Stuart Harrison. "Some of these instructors return after their military retirement to serve yet again."

Impact of Training

NGA has always supported training foreign partners for three reasons:

First, it is just good business. Many allies are co-producers. Co-production is the exploitation, processing and reporting of data by an approved facility, organization or foreign government with authority to apply data certification. Our warfighters can be assured of products meeting the

Over 250 international students have trained at the Defense Geospatial-Intelligence School in the past three years.

Photo by Larry Franklin

Lieutenant Colonel Alan Othen, United Kingdom Defence Imagery and Geospatial Liaison, briefs the Joint Staff Officer Course at the Defense Geospatial-Intelligence School.

same high standard since the producer had the same level of training.

Secondly, NGA has agreements with countries based upon Foreign Military Sales (FMS). Our allies need to understand how geospatial intelligence (GEOINT) supports military equipment—from aircraft to tanks—that uses NGA datasets.

Lastly, military commanders desire to improve their information superiority posture, and GEOINT is a critical component of interoperability. For example, in 2004 DGS sent an instructor to Iraq to train Iraqi Ministry of Defense and Ministry of Interior personnel.

Mobile teams from the Defense Geospatial-Intelligence School conduct training for host units, as reflected by this assemblage of course materials and equipment ready for shipment.

"This was very worthwhile training," the instructor noted in his after-action report. "The Iraqis who will be using this training are supplying information for action by our forces. They are using this training to build target folders. The better the target folders, the better our forces can act on the information provided."

Commonwealth Partnerships

The relationship with our allies isn't just one-way. Several instructors on staff received graduate training from the Royal School of Military Survey (RSMS). RSMS is an advanced civil schooling option available to senior military officers through exchange agreements between NGA and the United Kingdom Defence Geographic Intelligence Agency (DGIA). The program of instruction is 15 months long and involves in-depth instruction in surveying principles, geospatial analysis and lithographic-production, capped with a three-month long individual project. The end result is a master's or postgraduate degree in Defense Geospatial Information. This schooling is followed by a three-year utilization tour at NGA.

Also, DGS has begun using liaison officers from our Commonwealth partners as subject matter experts for in-residence courses. Lieutenant Col. Alan Othen, the United Kingdom Defence Imagery and Geospatial Liaison, and Maj. Ed Batchelor, who serves on the Geomatics and Imagery Staff of Canada's National Defence Headquarters, recently briefed the Geospatial Information and Service Joint Staff Officer

Course on the perspective of coalition partners. As a result, U.S. students gained insight into the similarities and differences between our respective systems to enable better interoperability.

International students have requested DGS courses from a broad range of instruction, from the introductory level to the advanced. Training and education is now available in Advanced Geospatial Intelligence (AGI), formerly called Imagery-Derived Measures and Signatures Intelligence. Several courses are available in geographic information systems, and there are courses specifically designed to support military operations.

Most training is conducted at Fort Belvoir, Va., or the Navy Yard in Washington, D.C. However, courses such as "Geospatial Information and Services (GI&S) for the Warrior" are taught by mobile training teams that have visited Australia, Canada, Chile, El Salvador and Iraq in recent years. GI&S for the Warrior covers basic geodesy, product accuracy, accessing NGA data, and exploitation of various data types. Practical exercises center on military scenarios, which can be performed in a mobile computer lab. Designed for U.S. military intelligence and engineer units, as well as Intelligence Community analysts, GI&S for the Warrior has been requested by infantry and special forces, reconnaissance teams and specialists in civil affairs, law enforcement, counterintelligence and human intelligence, including international partners.

A U.S. Marine Corps instructor from the Defense Geospatial-Intelligence School demonstrates surveying techniques to a class of International students.

How to get training

Training coordinators are responsible for enrolling U.S. students in DGS courses. Members of co-producer nations request training through NGA's Office of International Affairs and Policy. All others should contact their NGA Support Team, U.S. liaison officer or national liaison officer.

For international students in residence at Fort Belvoir, the International Military Student Office (IMSO) provides assistance to international students from arrival to departure. IMSO can pick up students at the airport and help them get a rental car and lodging. It also assists with visitor badges for entry to the post. IMSO helps students get acclimated to the DGS campus and provides an overview of the services available on post. It can arrange for visits to embassies and Washington-area sights. Upon departure, students receive a force-protection briefing from IMSO.

Requests for training should be made at least three months prior to the desired start date. The school can accommodate shorter notice if operations dictate, but advanced scheduling allows instructors to contact students to determine the best program of instruction, identify additional datasets needed, work through disclosure and release issues, and prepare for travel.

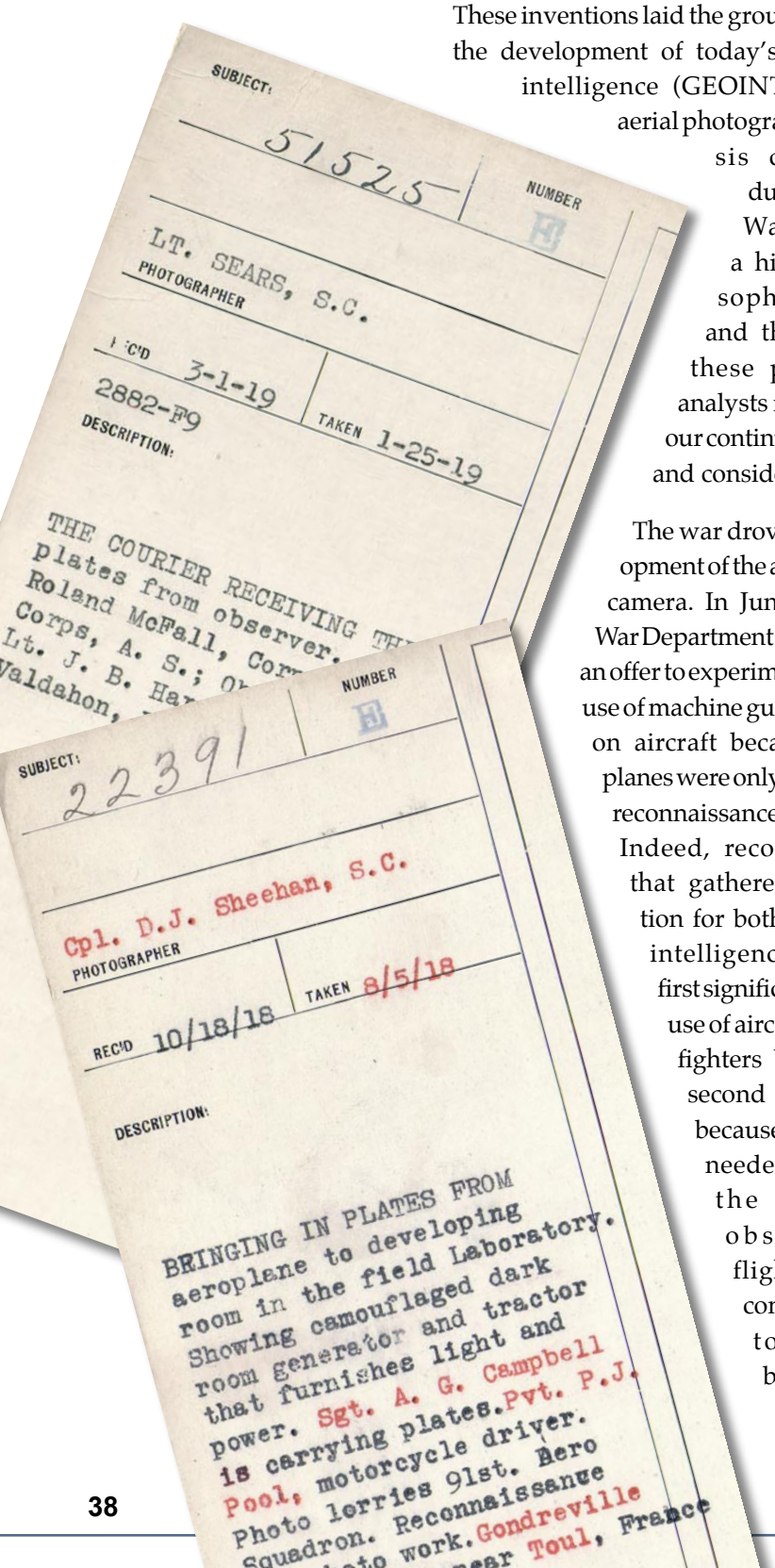
DGS welcomes the opportunity to deliver this training to our allies. "The College is dedicated to being a center of expertise for GEOINT training and education for our international partners," says the DGS Commandant. "We want to maximize the benefits of these opportunities."

NGA training announcements and points of contact are posted at www.nga.mil/td.

Beginnings of the Modern Age

By Dr. Martin Gordon

The airplane and the modern camera came into use just in time for the start of World War I in 1914. These inventions laid the groundwork for the development of today's geospatial intelligence (GEOINT). Yet the aerial photographic analysis conducted during World War I attained a high level of sophistication, and the work of these pioneering analysts is worthy of our continuing respect and consideration.



The war drove the development of the airplane and camera. In June 1912, the War Department had rejected an offer to experiment with the use of machine guns mounted on aircraft because "aeroplanes were only suitable for reconnaissance purposes." Indeed, reconnaissance that gathered information for both maps and intelligence was the first significant military use of aircraft. Pursuit fighters became the second application because they were needed to block the enemy's observation flights. Aerial combat began to evolve, but the need for aerial reconnaissance and aerial photographs was the first significant mission for aviation in World War I.

The use of balloons, dating back to the Civil War, continued but their usefulness was limited by their tethers and by their need to stay several kilometers behind the front. Balloons needed that distance so that anti-aircraft defenses and airplanes could protect them from being shot down by enemy fighters. Despite these drawbacks, balloons were critical for aerial observation in support of artillery targeting. They provided a stationary platform for continual observation of the front lines. Ground commanders had continual access to this real-time intelligence via telephone.

The use of scouting aircraft marked the beginnings of our ability to move above the Earth's surface in an organized manner. Likewise the development of the camera marked the beginnings of our ability to record what we were seeing above the Earth in an organized manner. The growth of both technologies has influenced the technological and organizational development of NGA and its predecessors from then to now.

Whether captured by balloon or airplane, the aerial photograph was considered the primary source of intelligence by the allies in World War I. The static nature of the Western Front gave high importance to repeated aerial photography of the same areas. These photographs gave photo interpreters the ability to look for change. Change could indicate a coming offensive, a withdrawal or a re-supply—all analyses field commanders would need as soon as it became available.

Just as NGA's Mobile Integrated Geospatial-Intelligence Systems (MIGs) today move with their headquarters to supply current information, so aerial photographic processing laboratories moved to where the aerial reconnaissance flights landed. Pilots looked for close, clear fields they could use. The labs processed the film as soon as a plane landed and rushed the photographs by motorcycle to their headquarters. There, the waiting interpreters quickly studied the photographs and reported their findings. This process gave the battlefield commander current actionable intelligence and maps quickly. These maps were based on a newly developed grid system.
This enabled the new over-the-horizon, long-range artillery to accurately attack targets their gunners could not see.

The warfighters' needs for accurate maps and intelligence drove the development of the airplane and camera. Even more importantly, these new technologies empowered cartographers and intelligence analysts as they used their imagination in putting the new technologies to use.

Terry Finnegan, Adjunct Professor, Joint Military Intelligence College, contributed to this article.

A courier receives the photographic plates from an observer.

The photographic plates are brought to a developing room in a field laboratory near Taoul, France.

21st Century

Romania Provides Real-Time GEOINT in Iraq

By Lieutenant Colonel Dan Raducanu
Military Technical Academy, Romania

Romania's Integrated Imagery Intelligence System (I3S) is an outstanding example of how U.S., Coalition and Iraqi troops on the ground are the direct beneficiaries of multinational collaboration in geospatial intelligence (GEOINT). The I3S concept, like GEOINT doctrine, merges imagery intelligence and mapping, charting and geodesy activities to support operations in real time.

Developed at the Military Technical Academy in Bucharest, Romania, the system has been applied quite successfully during Operation Iraqi Freedom.

The I3S was used in GEOINT missions in An Najaf, a city about 160 kilometers (96 miles) southwest of Baghdad within the Polish Multinational Division's area of responsibility. Najaf is centered on a mosque that enshrines the remains of Imam Ali, Muhammad's cousin and successor. Shiites from across Iraq, Iran and elsewhere in the Shiite world ask to be buried near the Imam Ali mosque.

Stretching for miles to the north and east of the mosque, Wadli al-Salam (Valley of Peace) cemetery is one of the largest in the world. At least 100 funerals a day take place in and around the cemetery. The intense activity offered the perfect cover for insurgent operations. Although international rules prohibit the use of cemeteries and mosques in warfare, the cemetery was full of unexploded ordnance, booby traps and ammunition/weapons caches.

The dense maze of Muslim tombs and domes became a treacherous battleground for U.S., Coalition and Iraqi forces fighting militiamen of Shiite Muslim Cleric Muqtada al Sadr.

Fortunately, a real-time GEOINT operation led to the successful discovery and capture of numerous possible Muqtada militia weapons and ammunition caches.

Exploiting a combination of commercial multi-spectral and multi-temporal real-time imagery and video taken by unmanned aerial vehicles, the Romanian Imagery Intelligence Team was able to identify and track enemy vehicles transporting and hiding ammunition and weapons within the Wadi Al Salam Cemetery.

This operation clearly demonstrates the critical role that GEOINT provides in support of Coalition military operations and highlights the benefits derived from expanding NGA's collaboration and cooperation with America's allies and partners.

Romanian soldiers form a line across the field as they practice riot control procedures during a Partnership for Peace situational training exercise at Marine Corps Base, Camp Lejeune, N.C. Romanian troops are currently supporting the United States in both Iraq and Afghanistan.

DoD photo by Pfc. Jeremiah Lancaster, U.S. Army

Partnerships

British Work with NGA to Tag the World's Places

By W. Glen Lauber and Randall Flynn

Nature, history and culture endow all locations with distinguishing features and characteristics. Ages ago, people started naming places to make them easier to identify. "Washington" is easier to remember than either a geographic coordinate or "federal city where the Potomac River and the Anacostia River merge." If, however, there are multiple "Washingtons" or variations on the name, people can go to the wrong place, harming commerce, costing money and confusing armies.

Confucius was once asked what he would do first if entrusted with a territory.

"My first task would certainly be to rectify the names," Confucius replied, as recounted on the Web site of the Permanent Committee on Geographic Names for British Official Use (PCGN) at www.pcgn.org.uk.

"If the names are not correct, if they do not match realities, language has no object. If language is without object, action becomes impossible—and therefore all human affairs disintegrate and their management becomes pointless and impossible."

Collaboration on Names

Those who practice this Confucian wisdom for the English-speaking world are the U.S. Board on Geographic Names (PGN) and the PCGN. For foreign geographic names, NGA's Political Geography Division provides executive, staff and analyses functions for the BGN. In their collaboration to adopt standardization policies, NGA's BGN staff and PCGN are in daily contact over issues of culture, linguistics and politics related to place names. The BGN and PCGN also meet in conference biennially, alternating the host country, to review progress, harmonize policy issues, and set the agenda for the next two years.

The two organizations analyze source material, such as maps and official language polices, for place-name information, share their analyses, develop joint policies for treatment of foreign place names, and recommend definitive names and spellings for use by the governments of the United Kingdom and United States. This work is informed by an understanding of the cultural and political factors influencing changes in names and writing systems.

The Political Geography Division recommends name updates and changes to the BGN. Adoption by the BGN makes the names official U.S. policy.

The BGN staff within the Political Geography Division and PCGN also collaborates in maintaining the Geographic Names Data Base (GNDB). NGA operates and maintains the GNDB, which is available on the World Wide Web at http://earth-info.nga.mil/gns/html/index.html as well as on internal networks. Foreign and domestic geographic names are maintained in separate databases, with the U.S. Geological Survey responsible, on behalf of the BGN, for domestic place names.

Historical Ties

The United States and United Kingdom took different paths to their collaborative relationship on names. In 1890 President Benjamin Harrison created the BGN by

executive order. In 1919 the British government established the PCGN. While the BGN was chartered initially for domestic names, as befitted an isolationist country in the Victorian Age, the PCGN worked exclusively on foreign place names, as befitted a worldwide empire.

After World War II ended the power of, if not the existence of, American isolationism, the BGN focused more intently on foreign geographic names. Public Law 242, passed by the 80th Congress and signed into law by President Harry S. Truman in 1947, gave the Board a legislated mandate and also increased the membership of the BGN to include the newly created Department of Defense and Central Intelligence Agency.

It was not long after Congress re-established the BGN that the Board and PCGN decided it was important for both groups to work together. An NGA predecessor organization (on behalf of the BGN) and the PCGN became partners in this quest. With the Political Geography Division taking over from the NGA predecessor organization, this crucial relationship remains active.

New Importance of Names

In conventional wars, big cities mattered to large, moving armies, who needed their roads, rails, warehouses and factories. It was easy to know and find Stalingrad, Manchester or Rotterdam. Today, every village is a potential communications, logistics and manufacturing center for war.

Confucius knew the importance of rectified domestic place names to the creation of a unified state. Our post-World War II forebears knew the importance of standardized foreign place names in an ever-shrinking world. Today, we face an enemy organized in cells and living in small places. It is critical to know where those places are and what they are called—not just by Westerners but by the local populace.

Understanding this crucial component of human geography allows us and our partners to conduct meaningful analysis of raw intelligence, including imagery, which can be acted on within minutes or hours.

The Political Geography Division of NGA collaborates with other organizations to standardize place names, such as the ones shown on this map, which can have significant cultural, political and philological meaning.

WWW.NGA.MIL